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RELATIVE ABUNDANCE OF GEORGIA CAPRIMULGIDS BASED ON CALL-COUNTS

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In recent years there has been much interest in the southward range expansion of the Whip-poor-will (*Caprimulgis vociferus*). Baker and Peake (1966) made several listening counts for Whip-poor-wills and Chuck-will's-widows (*C. carolinensis*) around Athens, Georgia, and determined that the Whip-poor-will was extending its summer range southward to include the lower Piedmont of Georgia. Allen (1979) found the Whip-poor-will to be fairly abundant in the suburban areas of Clarke County although it was greatly outnumbered by the Chuck-will's-widow. He reported substantial clustering in the local distribution of the Whip-poor-will, so that in some places it had actually replaced the Chuck-will's-widow. Prior to this, the Whip-poor-will had been described as "an uncommon transient south of the mountain counties" (Burleigh 1958). Odum (1943) reported the Whip-poor-will as not having substantially changed its distribution in the previous 35 years. By 1968, however, the Whip-poor-will was listed as a locally common summer resident around Athens, Georgia (Tramer 1968). The Chuck-will's-widow has always been a common summer resident in this area.

Because caprimulgids are often heard but seldom seen, listening counts made at periodic intervals along secondary and dirt roads are a logical way to determine their abundance. Brauner (1952) related dawn and dusk activity of Poor-wills (*Phalaenoptilus nuttallii*) to light intensity, and related duration of the active period of this species to several factors, especially moon phase. Mengel and Jenkinson (1971) also mentioned the importance of moonlight relative to caprimulgid calling activity. Harper (1938) found that on moonless nights, Chuck-will's-widow's singing appeared to be limited to brief periods at dusk and daybreak. On moonlit evenings, however, the birds continued to sing indefinitely. Baker and Peake (1966) mentioned the negative effect of wind on calling. These and other studies, however, have varied in both techniques and results so that the information is of little comparative value (Dillenbeck 1967, Nunley 1960).

The purpose of this study was to determine the relative abundance of Chuck-will's-widows and Whip-poor-wills in Clarke County, Georgia, from a series of call counts, and to correlate different environmental factors with calling activity.

METHODS

Athens, a city of 50,000 people, is located in the geographic center of Clarke County, which is characterized by gently rolling hills of red clay subsoils, with an average elevation of 700 ft (228.5 m). During the last 50 years the county has experienced much urbanization with numerous suburban developments.

In the southeast portion of the county, 20 roadside listening counts were made by the author from 13 April–23 July 1975, along main, secondary and dirt roads. Twenty permanent stations were established at approximately 0.5 mile (0.8 km) intervals. Barnett Shoals Road, a main road in a partially suburban area, contained the first 7 stations. The next 7 stations were on Belmont Road, a paved road running through farm land largely maintained as improved pasture. The final 6 stations were along a dirt road extending into pine-hardwood forest. Thus, it was possible to categorize the counts by land use type: either suburban, pasture, or forest. The counts were started from alternate ends of the route each evening at sundown, unless birds started to call prior to sundown. No counts were made at dawn. The time spent at each station was standardized at 3 min, although it was sometimes necessary to spend slightly more time at a station where many birds were calling. At each station the number of Whip-poor-wills and Chuck-will's-widows was recorded, in addition to vigorousness of song. Every effort was made to avoid counting the same bird twice. Data for 2 counts that took place during moderate to heavy rain were not included in the statistical analysis. Weather data were obtained from records at the nearby Clarke County Airport.

The effects of 7 variables (calendar date, sine curve date, temperature, relative humidity, visibility, wind velocity and moon phase) upon the number of calling Chuck-will's-widows and Whip-poor-wills were tested using the SAS statistical package programs (Barr and Goodnight 1972). Correlation procedures were used for Chuck-will's-widows and Whip-poor-wills both individually and collectively. Moon phase was expressed as a value on a 180° sine curve using the formula:

$$\text{moon phase} = \sin\left[180°\left(\frac{\text{nights since last new moon}}{\text{total nights between new moons}}\right)\right]$$

On nights when the count took place before moonrise, moon phase was treated as a new moon, with a value of zero. Date was expressed as both calendar date and as a value on a 360° sine curve using the formula:

$$\text{date} = \sin\left[360°\left(\frac{\text{day in year}}{365}\right)\right]$$

where day 1 is the vernal equinox.

Differences between numbers of Chuck-will's-widows and Whip-poor-wills in each habitat type was tested using Student's *t*-test. Differences in numbers of the same species between different habitat types were tested using analysis of variance and least significant difference procedures (Steel and Torrie 1960).

On the night of 24–25 May, a full lunar eclipse occurred. On this night 3 counts were taken: one during the waning period, one during the period of total eclipse, and one during the waxing period.

RESULTS AND DISCUSSION

Of all variables tested, moonlight had the most striking effect on singing activity. Only phase of the moon and calendar date showed significant correlations with numbers of singing birds. Moon phase showed a partic-

TABLE 1

TABLE OF CORRELATION COEFFICIENTS FOR TESTED VARIABLES POSSIBLY AFFECTING CALLING OF WHIP-POOR-WILLS AND CHUCK-WILL'S-WIDOWS

Variables	Singing birds		
	Whip-poor-wills	Chuck-will's-widows	Both species
Calendar date	−0.3899	−0.1747	−0.2877
Sine curve date	0.1681	0.3616	0.2591
Temperature	0.0557	0.3246	0.1825
Relative humidity	−0.0126	0.2325	0.1031
Wind velocity	0.2229	−0.0264	0.1049
Visibility	−0.0241	−0.2469	−0.1292
Moon phase	0.6372*	0.3841	0.5167**

* Significant at $P = 0.01$ level.
** Significant at $P = 0.001$ level.

ularly strong relationship ($r = 0.52$, $P \leq 0.001$) with numbers of singing birds. R^2 values were acceptable. Table 1 shows correlation coefficients of tested variables for Chuck-will's-widows, Whip-poor-wills and total birds. Moon phase showed a significant correlation ($P \leq 0.01$) with total numbers of singing birds and with Whip-poor-wills, but not with Chuck-will's-widows.

Except for moonlit nights, singing usually was restricted to the period between sunset and darkness. Singing Chuck-will's-widows and Whip-poor-wills were recorded 2.23 times as often and 3.15 times as often, respectively, when the moon was greater than half full as opposed to less than half full. The greatest single total for an evening was on the moonlit night of 27 April, when 80 birds were recorded. Some of these, and some on earlier counts, may have been transients. The full moon in May yielded similar results, but by July the birds seemed to have ceased most of their singing. No counts were taken during the full moon in June. Total numbers of calling birds of both species are shown in Fig. 1. Two counts that were subsequently eliminated from statistical analysis were taken during moderate to heavy rain, during which neither species was heard. Chuck-will's-widows were heard, however, on the evening of 31 May, when the rain slowed to a drizzle. Periods of high humidity did not lessen singing activity in either species, and periods after rains were highly productive (the 27 April count of 80 birds took place after a heavy rain with a relative humidity of 90% that evening).

Differences in numbers between species in different habitat types were tested using Student's t-test ($P \leq 0.05$). The results, not shown, are summarized as follows: (1) No significant difference in numbers of Chuck-

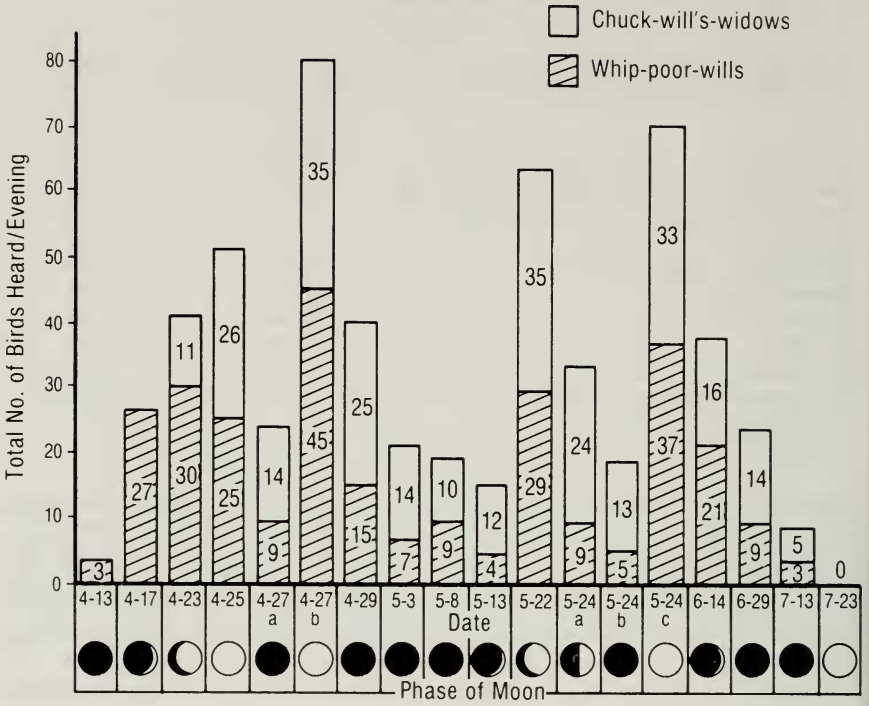

FIG. 1. Total numbers of birds recorded per count.

will's-widows and Whip-poor-wills was observed in the Barnett Shoals Road area. A total of 86 Chuck-will's-widows and 71 Whip-poor-wills was counted in this primarily suburban area. (2) A significant difference was observed between numbers of the 2 species in the Belmont Road area. The open habitat associated with pasture land was more favorable to Chuck-will's-widows. A total of 133 Chuck-will's-widows and 81 Whip-poor-wills was counted. (3) A significant difference was observed between numbers of the 2 species in the forested area in favor of Whip-poor-wills. A total of 70 Chuck-will's-widows and 129 Whip-poor-wills was counted.

Differences in numbers of the same species between habitat types were tested using analysis of variance and least significant difference procedures ($P \leq 0.05$). The results are summarized as follows:

(1) There was no significant difference between numbers of Chuck-will's-widows observed in the 3 habitat types.

(2) Whip-poor-wills were significantly more numerous in the forested area than in the other 2 habitat types. There was no significant difference between numbers of Whip-poor-wills observed in pasture and suburban areas.

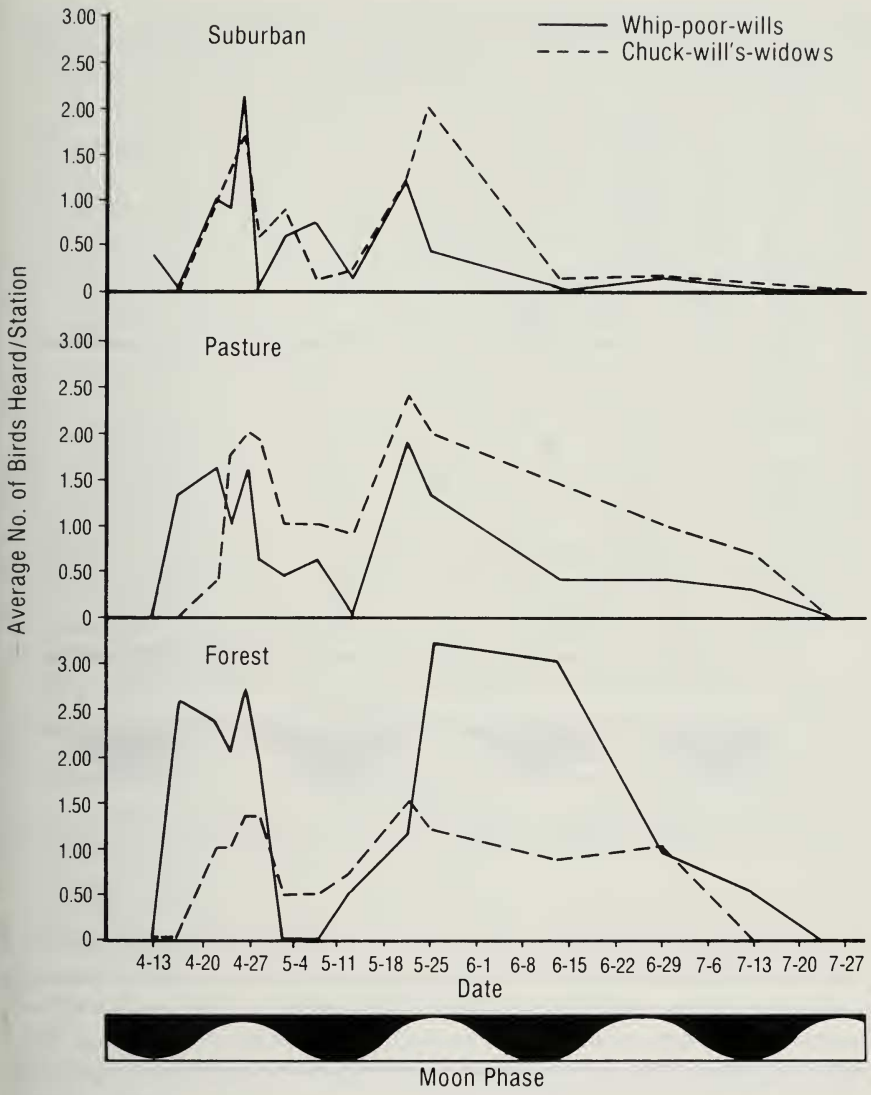

FIG. 2. The relative abundance of Whip-poor-wills and Chuck-will's-widows in suburban, pasture and forested areas.

Fig. 2 compares numbers of Chuck-will's-widows and Whip-poor-wills in each habitat type. Fig. 3 compares numbers of 1 species in the 3 habitat types. Each set of graphs shows 2 peaks occurring at the full moon in April and May.

The literature concerning habitat preferences of Whip-poor-wills and

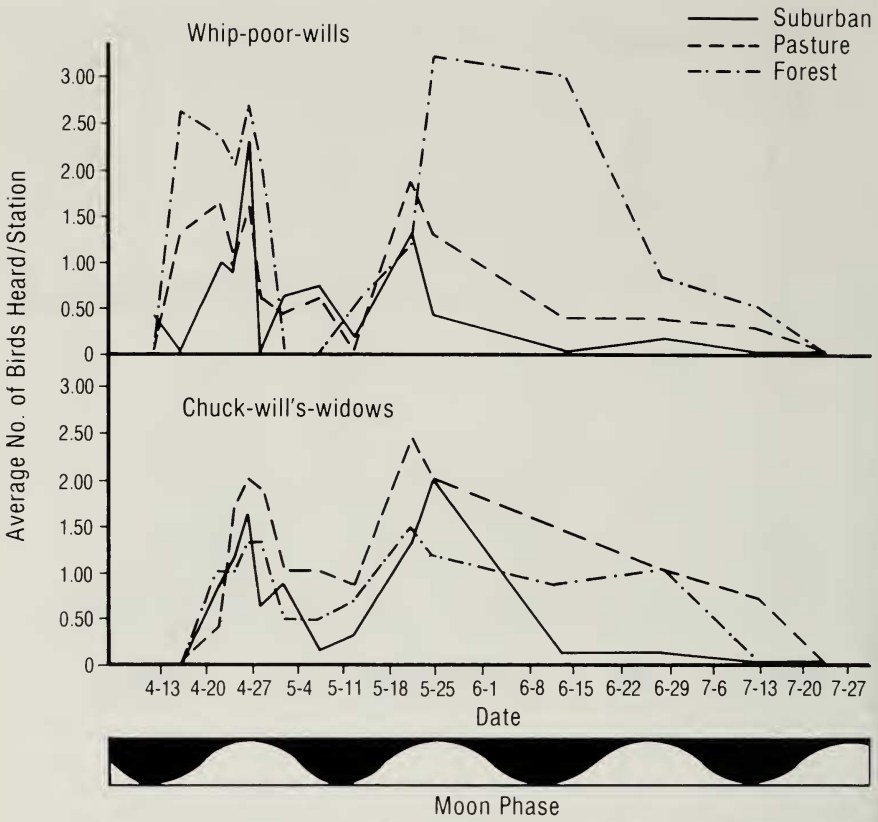

FIG. 3. The relative abundance of Whip-poor-wills and Chuck-will's-widows in 3 habitat types.

Chuck-will's-widows is inconsistent. In this study Chuck-will's-widows showed a relative affinity for open habitat and Whip-poor-wills showed a preference for wooded habitat. Bent (1940) reported Chuck-will's-widows active on the edges of woodlands bordering open field, often making sallies over the latter. Harper (1938) found that Chuck-will's-widows in the Okefenokee region preferred hammocks for roosting and more open country for feeding. Imhof (1976) reported both species occurring in woodlands of oak and pine. The Whip-poor-will was considered by Bent to be a woodland species that used small open areas for feeding. Allen (1979) found Whip-poor-wills in the Athens area to be restricted to a few areas, suburban in nature, characterized by a mixture of pasture and pine woods, with hardwoods restricted to creek bottoms. Baker and Peake (1966) found that the Whip-poor-will seemed limited to higher ground. Allen (1979)

could not confirm or refute this observation. In this study Whip-poor-wills were most abundant in the areas with the lowest elevation (<600 ft [182.8 m]), so that elevation can probably be eliminated as a limiting factor in range expansion of this species.

The southward range expansion of the Whip-poor-will appears to be related to a general southward invasion of northern species as discussed by Odum and Burleigh (1946). They noticed that Georgia lies at the end of the Appalachian mountain chain which acts as a funnel, permitting northern species to extend their ranges into the south. Evidence of a southward range expansion of the Whip-poor-will can be found elsewhere besides Georgia. In Alabama in 1924, the Whip-poor-will was listed as a mountain summer resident, restricted to the northeast section of the state (Howell 1924). Imhof (1976) mapped the Whip-poor-will's summer range to include areas of the Piedmont south of Birmingham, a substantial increase. Allen (1979) discussed factors contributing to the southward expansion of many species, and considered changes in land use to be significant in causing the Whip-poor-will's range expansion. From 1920–1940, cotton fields were abandoned in north Georgia and have subsequently produced extensive areas of forest. By 1973, 51% of Clarke County was wooded, compared to 38% in 1938. Allen (1979) determined that such an increase in forested land would be favorable for the Whip-poor-will.

The results of this study tend to corroborate Allen's (1979) findings in that the Whip-poor-will was significantly more abundant in forested areas than elsewhere in the study area and was significantly more abundant in forested areas than the Chuck-will's-widow. Since the Whip-poor-will was not recorded in Clarke County as a summer resident until 1956 and not as a breeder until 1971, change in land use contributes much as a logical explanation for this recent phenomenon.

Calling activity during an eclipse.—An unusual opportunity arose to reinforce my observations on the effect of moonlight on calling when, on the night of 24–25 May 1975, a total lunar eclipse occurred. On this night 3 counts were taken: 1 starting at full moon and continuing through the waning period, 1 during the period of total eclipse, 1 starting at total eclipse and continuing through the waning period to full moon again. The contrasts between counts were dramatic. The first count started with vigorous calling typical of a moonlit night, then decreased with a total of 24 Chuck-will's-widows and 9 Whip-poor-wills. The second count yielded only 13 Chuck-will's-widows and 5 Whip-poor-wills. The singing was also noticeably less vigorous. Half-way through the final count the moon was three-quarters full, and by the time it reached the full phase there were almost too many birds to count accurately, e.g., 33 Chuck-will's-widows and 37 Whip-poor-wills.

Table 2

Number of Calling Chuck-will's-widows (CWW) and Whip-poor-wills (WPW) During the Full Lunar Eclipse of 24–25 May 1975

	Waning period			Full eclipse		Waxing period		
Stop	CWW	WPW	Moon phase	CWW	WPW	CWW	WPW	Moon phase
1	2	—	Full	1	—	2	—	Ecl.
2	2	1	Full	1	—	1	—	Ecl.
3	2	1	Full	—	1	2	—	Ecl.
4	2	2	¾	2	1	1	1	Ecl.
5	3	—	¾	—	—	2	1	¼
6	2	2	¾	1	—	2	2	¼
7	1	1	½	—	1	2	3	¼
8	—	—	½	—	—	1	2	½
9	1	—	½	1	—	2	—	½
10	1	—	¼	1	—	2	1	½
11	1	—	¼	—	—	2	1	¾
12	—	—	¼	—	—	2	2	¾
13	2	—	Ecl.	2	—	3	3	¾
14	1	1	Ecl.	1	1	2	2	Full
15	1	—	Ecl.	—	—	—	2	Full
16	—	—	Ecl.	—	—	1	2	Full
17	1	—	Ecl.	1	—	2	3	Full
18	—	1	Ecl.	—	1	1	5	Full
19	1	—	Ecl.	1	—	2	3	Full
20	1	—	Ecl.	1	—	1	4	Full
Total	24	9		13	5	33	37	

None of the other tested variables changed appreciably during this period; thus, the change in numbers of calling birds is likely related to the change in moon phase. For a complete record of the lunar eclipse counts, see Table 2.

SUMMARY

A series of call counts was taken from 13 April–23 July 1975, to determine relative abundance of Chuck-will's-widows and Whip-poor-wills in Clarke County, Georgia, and to determine how different environmental variables affected calling behavior. A 20-station route was separated into 3 general habitat types: suburban, pasture and mixed forest. Student's *t*-test was used to test differences between numbers of the 2 species in each habitat type. Analysis of variance and lsd procedures were used to test differences in numbers of 1 species between habitat types. Tests were made for correlations between numbers of calling birds and different environmental variables. Overall, Whip-poor-wills were approximately as abundant as Chuck-will's-widows in the study area. Whip-poor-wills were significantly more numerous in forested habitat than Chuck-will's-widows and the opposite was true in open habitat. Whip-poor-wills were significantly more numerous in forested habitat than in open

or suburban areas. Chuck-will's-widows were approximately equally abundant in all 3 habitat types. Change in land use from agriculture to forest is offered as a partial explanation for the south-ward range expansion of the Whip-poor-will. Of all variables tested, moon phase showed the strongest correlation with numbers of singing birds. This observation was supported by a series of counts taken during a total lunar eclipse, during which numbers of singing birds varied directly with moon phase.

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